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(19) JAPANESE PATENT OFFICE

PATENT ABSTRACTS OF JAPAN

(11) Publication number: **08108049 A**

(43) Date of publication of application: **30.04.96**

(51) Int. Cl **B01D 63/02**

(21) Application number: **06249281**

(22) Date of filing: **14.10.94**

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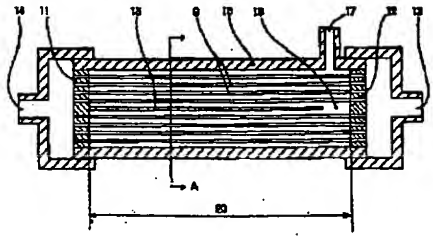
(54) HOLLOW FIBER MEMBRANE TYPE MODULE

(57) Abstract:

PURPOSE: To prevent the packed quantity of hollow fiber membranes from being reduced while making the flow of a gas flow outside the hollow fiber membranes approach a contercurrent model by forming no opening within a specified distance from one sealing part to a partition installed in the hollow fiber membrane and making a part exceeding it have an opening.

CONSTITUTION: Plural hollow fiber membranes 9 are fitted in a housing 10, and both the ends of the hollow fiber membranes 9 are sealed in a housing 10 with the inside of the membranes 9 being opened, and the housing is provided with connecting ports 13, 14 communicating with the outside of the hollow fiber membranes 9. And in the housing 10, a partition 15 of gas impermeable partition 15 is installed so that the hollow fiber membranes 9 may be divided into plural sets. The partition 15 has no opening at a position within a distance, at least 50% of the distance between one sealing part 11 (12), from the sealing part, and a part or the whole of a portion exceeding it is opened. In this way, performance approaching a countercurrent is realized, and the quantity of the hollow fiber membranes packed into the module is not reduced.



JP H08-108049,A

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention makes especially the inside of a hollow fiber a primary side about the improved hollow fiber mold module. It is a thing about the hollow fiber mold module used for the outside of the hollow fiber which is a secondary by the direction for use in which a gas contacts. For example, gas separation of nitrogen enrichment, hydrogen separation, helium separation, carbon-dioxide-gas separation, separation of the organic solvent steam in air, etc. (a steam is also included in the gas said here), In applications used for degassing, the devolatilization, and water / alcoholic separation, the water / organic solvent separation, etc. which removes gases, such as oxygen and carbon dioxide gas, and volatile matter, such as a trichloroethylene, from water, such as osmosis evaporation (pervaporation) and membrane distillation It is related with the hollow fiber mold module which raised the effectiveness of separation.
[0002]
[Description of the Prior Art] In membrane separation, a hollow fiber is usually used in the configuration of the module stored in housing. The typical structure is shown in drawing 1 . that is, a hollow fiber 1 loads housing 2, the shape of a bundle, the rolled-round condition, where a braid is carried out -- having -- the both ends of a hollow fiber 1 -- resin etc. -- the closure 3 and 3' -- by being carried out, the inside and the outside of a hollow fiber are separated and the inside of a hollow fiber is carrying out opening to the closure section end face 4 and 4'. It hits using a module, for example, separates into the nontransparent gas taken out from the end connection 6 which the mixture of gas is introduced inside a hollow fiber from an end connection 5 in the case of a gas-permeation-membrane module, and is the opposite edge of the hollow fiber inside, and the transparency gas which penetrates a hollow fiber and is taken out from an end connection 7 and/or 8. Or the mixture of gas is introduced into the outside of a hollow fiber, and it separates into the nontransparent gas which flows out of end connections 8 or 7, and the transparency gas penetrated to the hollow fiber inside taken out from an end connection 5 and/or 6 from end connections 7 or 8 again. At this time, it is made highest [effectiveness] in chemical engineering to pass mixed gas and transparency gas to a counterflow (counter-flow). However, in the module of the structure of drawing 1 , even if it tried so that mixed gas might be introduced into the hollow fiber inside and it might operate by the counterflow toward an end connection 6 a sink and by closing an end connection 8 on the other hand, and taking out transparency gas from an end connection 7 from an end connection 5, the concentration and yield of gas which are separated showed the engine performance near a crossflow (cross flow) mold fairly lower than a theoretical value. Moreover, the module of drawing 1 was used, and even if it performed the attempt which introduces mixed gas into an end connection 7, closes a sink and an end connection 6 toward an end connection 8 on the outside of a hollow fiber, and takes out transparency gas from an end connection 5, the still lower result was

only obtained. That is, in the hollow fiber mold module, it was difficult to realize the engine performance of the counterflow mold near the theory. Moreover, that a primary side is not a gas but a liquid only differed, and the situation was [in / degassing, the devolatilization or the pervaporation, or membrane distillation from a liquid] the same about that a counterflow mold is the most efficient and the ideal counterflow mold not being realized in a hollow fiber mold module.

[0003] In order to solve these problems, the cylinder of gas impermeability is loaded with the hollow fiber divided into two or more groups for every group, and the hollow fiber mold module with which this cylinder has 50 - 99.5% of die length of the die-length direction of the hollow fiber film is devised as indicated by publication of unexamined utility model application Heisei 5-51432 which is application by this invention persons. However, according to this design, although the engine performance near an ideal counterflow was realized, there was a fault said that the amount of the hollow fiber with which a module can be filled up decreases, and the throughput per module decreases.

[0004]

[Problem(s) to be Solved by the Invention] This invention aims at offering the hollow fiber mold module with which the amount of the hollow fiber with which it can be filled up does not decrease, bringing the flow of the gas of a hollow fiber outside close to an ideal counterflow model.

[0005]

[Means for Solving the Problem] this invention person etc. reached this invention, as a result of examining the above-mentioned technical problem wholeheartedly. Namely, as for the summary of this invention, the 1st is loaded with two or more hollow fibers into housing. After the membranous inside has carried out opening, the closure of the both ends of a hollow fiber is carried out into housing, respectively. And it is the hollow fiber mold module which has the end connection which leads to the outside of a hollow fiber. The septum of gas impermeability is formed so that a hollow fiber may be divided in housing at two or more groups. This septum does not have opening in the location from one closure section to at least 50% of the distance between the closure sections. It is in the hollow fiber mold module characterized by being that in which a part thru/or all exceeding it of a part is carrying out opening. It is the hollow fiber mold module by which the 2nd was loaded with two or more hollow fibers into housing, and the closure was carried out into housing, respectively after the membranous inside had carried out opening of the both ends of a hollow fiber. In housing, the septum of gas impermeability is formed over between [whole] both closure sections so that a hollow fiber may be divided into two or more groups. And any group of a hollow fiber is surrounded with a septum and housing. It is in the hollow fiber mold module characterized by preparing the channel which connects the end connection which leads to each space separated from one closure section of the inside of housing by the septum within the limits of 70 - 100% of the distance between the closure sections, and the outside of a hollow fiber.

[0006] This invention is further explained to a detail about the important section. As the 1st and 2nd modules (it collects below and considers as the module of this invention) of this invention looked at in drawing 2 -5, housing 10 is loaded with a hollow fiber 9, the both ends of a hollow fiber 9 are in the condition in which the inside (lumen side) of a hollow fiber carried out opening, respectively, and the space where between hollow fibers 9 leads to the closure 11 with resin etc., and leads inside a hollow fiber by taking 12 airtightly, and the space which leads outside are separated. In housing, you may paste up airtightly and the closure sections 11 and 12 may be airtightly fixed in housing by the O-ring etc. The end connection 17 which the end connections 13 and 14 of both ends which lead inside a hollow fiber 9 are formed separately, and leads to the outside of a hollow fiber is formed in housing. That is, it is the structure which a fluid is introduced

from the end connection of the end of a hollow fiber, and can be made to flow out of the end connection of the other end. Moreover, it has the structure which can take out the gas which penetrated the film, volatile matter, etc. from an end connection 17.
[0007] The description of the module of this invention is to divide a hollow fiber 9 into two or more groups by the septum 15 of gas impermeability, and to be loaded with it in addition to the above-mentioned structure. First, in the case of the 1st module, airtightly in contact with one closure section 11, it is fixed substantially, and the gas impermeable septum 15 does not have opening in the range from the closure section 11 to at least 50% of location of the distance between the closure sections, but a part thru/or all exceeding it of a part is carrying out opening. Opening means the part in which the septum is carrying out opening that the space surrounded with septa or a septum, and housing should connect with an end connection 17. The distance between the closure sections here means the distance between the module inside end faces (a hollow fiber is not the end face which is carrying out opening) of the closure sections 11 and 12. When an inside end face is not parallel, it considers as mean distance. If opening exists in 50% or less of range of the distance between the closure sections, the part which works as a counterflow will decrease and decline in separation efficiency will be caused.
[0008] For example, from the closure section 11, at least 50%, in at least 90% of location, it does not have opening still more preferably, but has the opening 16 of a septum into the part exceeding it of the distance between the closures at least 80% preferably so that drawing 2 may see. The configuration of this opening is arbitrary and can be established by digging a hole to a septum. The number and configuration of a hole are arbitrary. A hole may be circular and may have the shape of the shape of a slit, or a wedge, for example. A hole may exist in the above-mentioned whole range, and may exist in the part. Extent which does not become gaseous transparency resistance has much opening, or its large thing is desirable. Since the magnitude of the range where the opening 16 of a septum exists does not serve as gaseous transparency resistance, 0.5% or more of its distance between the closure sections is desirable, and it is still more desirable that it is 2% or more.
[0009] Moreover, from the closure section 11, at least 50%, at least 80% of septa 15 exists in the range to at least 90% still more preferably preferably, and that to which some or all of a septum is missing in the part exceeding it of the distance between the closure sections is also contained in this invention so that drawing 3 may see, for example. The configuration of the deficit section 18 of a septum may be arbitrary, and may be the configuration from which the septum was cut by the right angle to the longitudinal direction of housing, the configuration cut aslant, or other complicated configurations. When the cutting plane of a septum is not right-angled to the longitudinal approach of housing, the die length of a septum is carried out with the average. Since the die length of the deficit section 18 of a septum does not serve as gaseous transparency resistance, 0.5% or more of its distance between the closure sections is desirable, and it is still more desirable that it is 2% or more.
[0010] As for the end connection 17 which should take out a gas, it is desirable to be prepared in the location near opening 16 or the deficit section 18. That is, as for the location of an end connection 17, it is preferably desirable that it is the part still more preferably beyond at least 90% of location of the closure section 11 to the distance between the closure sections, and is a location near the closure section 12 by the side of opening 16 or the deficit section 18 at least 70% at least 50%. In addition, when the group of all hollow fibers is surrounded only by the septum so that it may mention later, the location of an end connection 17 is arbitrary.
[0011] Next, in the case of the 2nd module, as shown in drawing 5 , a hollow fiber 9 is divided into two or more groups by the septum 15 of gas impermeability, and it is loaded

with this module. The septum 15 is formed over between [whole] the closure sections (i.e., between the closure section 11 and the closure sections 12), and does not have opening. The configuration of the septum 15 in the A section cross section of drawing 5 does not have the group of the hollow fiber substantially surrounded airtightly only by the septum, and hollow fiber outside space touches housing about the group of all hollow fibers so that drawing 4 (b) may see.

[0012] The channel 19 which connects with a housing inside each space separated by the septum is formed, and this has connected with the end connection 17. A channel 19 leads the gas which flows the space separated from the end connection 17 by the septum 15 to an end connection 17. Therefore, the channel 19 is enough if the space which does not need to be prepared over the inside perimeter of housing 10 and was separated from the end connection 17 by the septum is prepared that an end connection 17 should be connected with. A channel may be the slot which had for example, the housing inside cut, may be formed by connecting housing with another bigger housing member than that of a bore like drawing 5 , and as a size bore part is in housing, it may be fabricated. That is, the gas which penetrated the hollow fiber 9 flows the inside of the space divided by the septum 15 toward a channel 19, without penetrating a septum 15 substantially, and is taken out from an end connection 17 out of a module through a channel 19.

[0013] the location of a channel 19 -- one closure section 11 to the distance between the closure sections -- it is preferably prepared in 90 - 100% of within the limits still more preferably 80 to 100% 70 to 100%. What is necessary is to be able to design the width of face and the height of a channel in the dimension to which pressure loss does not become high, and for a membranous gas transmission rate, modular magnitude, etc. just to determine them suitably. A channel may be plural. The plate and sheet with which the network and the hole were dug may be prepared in the boundary section of a channel 19 and a hollow fiber 9.

[0014] The septum 15 used by the module of this invention is gas impermeability substantially, and the gas which penetrated the hollow fiber 9 flows toward opening 16, the deficit section 18, or a channel 19, comes out of the inside of the space divided by the septum 15 from opening 16, the deficit section 18, or CHANNENRU 19, and is taken out from an end connection 17 out of a module. Gas un-penetrating means substantially that the quantity of gas which penetrates a septum 15 compared with the quantity of gas which passes opening 16, the deficit section 18, or the channel 19 of a septum is a negligible quantity.

[0015] The approach of fixing a septum 15 airtightly in contact with one closure section 11 in this invention substantially can take the approach of the method of arbitration being sufficient as, for example, closing a septum with a hollow fiber, the approach of pasting up on the closure section 11, the approach of fixing to housing 10, where the closure section 11 is touched airtightly substantially, etc. An airtight means substantially that it is a negligible quantity compared with the amount in which the quantity of gas which flows the gap of the closure section 11 and a septum 15 flows opening 16, the deficit section 18, or the channel 19 of a septum.

[0016] In the case of the 1st module, the configuration from which a septum divides a hollow fiber into two or more groups is arbitrary. For example, as the drawing 4 (**) which showed drawing 2 and the A section cross section of 3 sees, the group of all hollow fibers is surrounded with a septum and housing, hollow fiber outside space may touch housing, 4th [**] Fig. (**) sees, the group of all hollow fibers may be surrounded only by the septum and drawing 4 (Ha) sees, you may be the configuration in which both are intermingled. In the case of the 2nd module, it is surrounded with a septum and housing about the group of all hollow fibers as above-mentioned.

[0017] In this invention, the cross-section configuration of the space surrounded with the septa, the septum, and housing in a module may be a configuration of arbitration, and can also be differed for every space. The cross section of each space is also arbitrary and you may differ for every space. However, it is desirable that the values (this value is expressed as "an average diameter / distance between the closure sections" for convenience below) which **(ed) the average diameter of the space surrounded with septa or a septum, and housing in the distance between the closure sections are 0.01-0.1. In case of below this value, a manufacturing cost rises and the effectiveness of this invention falls. It is a diameter of circle equal to the average diameter of space to the cross sectional area of space. The cross section of the space of the direction where the cross section of space here is right-angled in a modular longitudinal direction, i.e., a hollow fiber, is said.

[0018] If the material and thickness of a septum are the thing of gas impermeability substantially, they may be the arbitrary for example, plates made from a polymer, a sheet, a film, etc., and its general-purpose resin which is easy to fabricate, such as a vinyl chloride and polyester, is desirable. A ** t septum may combine two or more things. Although it does not have to be carried out even if it has pasted up between septum 15 comrades and/or a septum 15, and housing 10 in any case, suppose substantially that it is airtight. Also in this case, an airtight means substantially that it is a negligible quantity compared with the quantity of gas to which the quantity of gas which flows these gaps flows opening 16 or the deficit section 18 of a septum. The filling factor of the hollow fiber in each space formed with septa, a septum, and housing is almost the same, and when the homogeneity of restoration is also almost the same, since it can ignore to the quantity of gas which passes opening 16 or the deficit section 18, even if the quantity of gas which passes through that even if there is a gap has some gaps, it becomes airtight substantially. However, when the case where the filling factors of the hollow fiber in each space formed with septa, a septum, and housing differ differs from the homogeneity of restoration, it is necessary to make this gap small. Moreover, as 4th [**] Fig. (b) sees, when the group of all hollow fibers is the thing thing surrounded only by the septum, it does not need to be airtight between a septum 15 and housing 10, and, in such a case, the location of an end connection 17 is arbitrary.

[0019] In this invention, the loading gestalt of the group of the hollow fiber with which the space surrounded with septa or a septum, and housing is loaded is arbitrary. For example, you may be an parallel hollow fiber bundle substantially, and may be the braid object or textiles which consisted of hollow fibers or a hollow fiber, and other lines of thread. You may fill up with the group of a hollow fiber in parallel with the space surrounded with septa or a septum, and housing, and may fill up with it aslant or spirally. However, the module of this invention has the largest engine-performance improvement effect, when filling up with the bundle of an parallel hollow fiber almost in parallel with this space mutually substantially, and it is desirable to consider as the bundle of an parallel hollow fiber substantially also from the effectiveness on production.

[0020] As for the lot of a hollow fiber, it is desirable to consist of 100-10000 hollow fibers. It is desirable that the group of a hollow fiber is an parallel bundle on parenchyma, and it is 1000-10000 when a hollow fiber outer diameter is 150-350 micrometers, and when a hollow fiber outer diameter is similarly 350-800 micrometers, it is desirable that it is 100-3000. If there are too many numbers of the hollow fiber of a lot, an engine-performance improvement effect will decrease, and if too few, a manufacturing cost will increase.

[0021] It is desirable that it is 25 - 85%, when the hollow fiber with which it fills up is an parallel bundle on parenchyma, as for the filling factor of the hollow fiber in a septum, it is desirable that it is 45 - 85%, and it is still more desirable that it is 60 - 80%. The filling factor said here is a thing [as opposed to / a thing / the cross section of each space

surrounded with septa or a septum, and housing] of the rate of the cross section of the hollow fiber with which this space was filled up. It can ask for a filling factor by count by the following formulas.

[0022]

[Equation 1]

$$\text{充填率 (\%)} = \frac{\pi r_0^2 n}{(\pi R_i^2 - 4 R_i T) / 4} \times 100$$

However, r0: A hollow fiber outer diameter / 2 n:hollow-fiber number Ri: A housing bore / 2 T: Thickness of a septum Unit (cm)

The filling factor in the case of the closest packing is about 91%. Although the effectiveness of this invention is demonstrated, if the one where a filling factor is higher is too high, the closure will become easy to become imperfect and the manufacture yield will fall. On the other hand, if a filling factor is too low, an engine-performance improvement effect will decrease. Although the hollow fiber filling factor of each space surrounded with septa or a septum, and housing does not necessarily need to be equal, a thing high equally as much as possible is desirable.

[0023] When the module of this invention has a flexible hollow fiber, effectiveness may not be demonstrated, but effectiveness is demonstrated especially when upright. Although the reason is unknown, when a hollow fiber is upright, it thinks because homogeneity is easy to fill up with a hollow fiber to the corner of the space divided by the septum. Therefore, as for the hollow fiber used for this invention, what has it is desirable. [desirable a thing made from an upright polymer with a high glass transition temperature like polyimide or polysulfone and comparatively thick] when the outer diameter of a hollow fiber takes into consideration the film surface area with which a module is filled up, it is 200-700 micrometers -- it is desirable and it is still more desirable that it is 300-500 micrometers.

[0024] Moreover, the configuration of housing is arbitrary. When a circle uses two or more modules preferably from the ease of acquisition of a material, the square of the cross-section configuration of housing is also desirable in the semantics which decreases occupied volume. Moreover, also in the 1st module, it is also desirable about a longitudinal-section configuration by having a channel as well as the 2nd module in coincidence, and making the cross sectional area of the closure section of housing larger than the hollow fiber restoration section to consider as the structure which lowers the filling factor in the closure section, keeping high the filling factor of the hollow fiber restoration section. Moreover, you may be for example, not only the shape of a straight pipe but U typeface. However, in most range where a septum exists in any case, it is desirable that the filling factor of a hollow fiber is almost equal. Two or more sets of parts excluding housing from the module of drawing 2 are able to be loaded during two or more modules sharing housing, for example, one housing. Moreover, it is also possible to share other modules and housing of structure.

[0025] It is a thing about the hollow fiber mold module which each module of this invention makes the inside of a hollow fiber a primary side, and is used for the outside of the hollow fiber which is a secondary by the direction for use in which a gas contacts. Fluids containing a gas or volatile matter, such as a liquid and mixed gas, are introduced into the hollow fiber inside. Make a gas, volatile matter, or the separated gas penetrate from a hollow fiber outside. It is suitable especially as a module for gas separation, and by introducing the fluid introduced into a primary side from the end connection 13 of the side near opening 16, the deficit section 18, or the channel 19 of a septum 15, it works as a counterflow mold module and the engine performance is demonstrated.

[0026]
[Example] This invention is not limited by these examples although an example explains this invention still more concretely below.
[0027] As shown in [example 1] drawing 3 and drawing 4 (b), were divided into four parts by the septum with a thickness of 1mm made from rigid polyvinyl chloride. To four space of cylindrical housing with a die length [of 60cm], and a bore of 100mm made from rigid polyvinyl chloride, respectively 2000 The outer diameter of 450 micrometers, the bore of 240 micrometers, the oxygen transmission rate 2.2x10-5 (cm [3 (STP)] / sec [cm2 and sec], cmHg), It was filled up with the hollow fiber made from polysulfone of oxygen / nitrogen separation factor 6.1 almost in parallel, 2 liquid type epoxy resin cut the back end section which carried out centrifugal closure of the both ends, and the module whose closure section thickness is an average of 5cm and 50cm of mean distances between the closure sections was produced. At this time, one [which loaded with the hollow fiber 9] edge of a septum 15 was embedded in the closure section 11, and was closed, and the die length from the inside of the closure section 11 to other edges of a septum 15 is 45cm, and it was set up so that the part into which the septum 15 suffered a loss might be set to 5cm. Although the septum of each other is pasted up, between a septum and housing, it is only having touched and has not pasted up. The end connections 13 and 14 which the end connection 17 is formed in the location which touches the closure section 12 of the side near the opening 16 of a septum, and are connected to the hollow fiber inside are formed in housing. If it asks for the filling factor of a hollow fiber in the formula which set the circular constant to 3.14 and was shown by several 1, it will be calculated with 66.5%. Moreover, an average diameter / distance between the closure sections = it is 4.93 / 50= 0.099.
[0028] The air of 0.7MPaG(s) (it is shown that G is gage pressure, i.e., the pressurization pressure of atmospheric-pressure criteria) was introduced into the hollow fiber inside, the flow rate adjustable valve was connected to the end connection 14, and the nontransparent gas was taken out from the end connection 13 of the side near the deficit section 18 of a septum of this module. On the other hand, the end connection 17 considered as atmospheric-air release, and discharged the gas which penetrated the hollow fiber. When the flow rate adjustable valve connected to the end connection 14 was adjusted so that the nitrogen concentration of the gas taken out from an end connection 14 might become 99.0%, the flow rate of the nitrogen enrichment air taken out from an end connection 14 was 0.245Nm3/o'clock (it is shown that N is normal, i.e., 0 degree C, and 1 atmospheric-pressure reduced property). Moreover, yield (ratio of the amount of ejection of nitrogen enrichment air to the amount of airstream ON introduced into an end connection 13) was 32.5%.
[0029] As shown in [example 2] drawing 2 , it is 60cm in overall length as a septum 15, and the hole of a large number with a diameter of 1cm was dug from the edge by only the range of 5-10cm, ****** which has opening 16 was used, it embedded each 5cm of both ends of this septum in the closure sections 11 and 12, and the same module as an example 1 was created except having formed the end connection 17 in the location near the opening 18 of a septum 15. From the end connection 13 of the side near the opening 16 of the septum 15 of this module, air was introduced into the hollow fiber inside and the same experiment as an example 1 was conducted. The result was completely the same as that of an example 1.
[0030] As shown in [example 3] drawing 5 and drawing 4 (b), the septum with an overall length of 60cm was used, it embedded each 5cm of both ends of this septum in the closure sections 11 and 12, and all the range between the closure sections was divided with the septum, The housing member with a bore of 12cm was pasted up in the 50cm part from the edge of housing, and the same module as an example 1 was created

except having formed the channel 19 over the pipe perimeter with a width of face [of 5cm], and a height of 1cm, and having formed the end connection 17 in the channel 19 section. From the end connection 13 of the side near the channel 19 of this module, air was introduced into the hollow fiber inside and the same experiment as an example 1 was conducted. The result was completely the same as that of an example 1.
[0031] In order to make the same that it is 7 division configuration by which the [example 4] septum 15 was shown in drawing 4 (Ha), and a filling factor, the same module as an example 1 was created except having made the hollow fiber into a total of 7850. The core of the average diameter / distance between the closure sections of this module was 0.062, and the periphery was 0.076. When the same experiment as an example 1 was conducted using this module, the flow rate used as 99.0% of nitrogen concentration was 0.25m3/o'clock, and yield was 33.0%.
[0032] 8210 hollow fibers were stored in housing as one parallel bundle on parenchyma, without using the [example 1 of comparison] septum 15, and also the module of this dimension was manufactured like the example 1. The filling factor of a hollow fiber becomes the 66.5 same% as an example 1. When the same experiment as an example 1 was conducted using this module, the flow rate used as 99.0% of nitrogen concentration was 0.22Nm3/o'clock, and yield was 30.0%.
[0033] The [example 2 of comparison] septum 15 is not used. Instead a hollow fiber, respectively The bore of 3cm, By loading seven cylinders with an outer diameter [of 3.2cm], and a die length of 50cm made from rigid polyvinyl chloride, including in with a bore die length [60cm die length of 10cm] housing, carrying out embedding of the 5cm of one edges to resin, and closing them The module of the structure where the range of 5cm of a hollow fiber is not covered in one edge between the closure sections currently indicated by publication of unexamined utility model application Heisei 5-51432 was produced. When the hollow fiber filling factor of each cylinder was made into the 66.5 same% as an example 1 at this time, the number of hollow filaments was not able to become 5166 and it was able to be filled up with it 64.6% of the example 1. When the same experiment as an example 1 was conducted using this module, the flow rate used as 99.0% of nitrogen concentration was 0.16Nm3/o'clock, and yield was 33.0%.
[0034]
[Effect of the Invention] Since the amount of the hollow fiber with which the engine performance near a counterflow is realized and it can be filled up to a module by using the module of this invention does not decrease, in gas separation, the increment in concentration of a concentration gas, the increment in yield, and reduction of kinetic-energy cost can be measured. Moreover, in degassing and devolatilization of a liquid, reduction of residual gas concentration or residual volatile-matter concentration, the increment in throughput, and reduction of kinetic-energy cost can be measured. Furthermore, also in osmosis evaporation or membrane distillation, the increment in concentration of a concentration liquid, the increment in yield, and reduction of kinetic-energy cost can be measured. Moreover, also in which direction for use, a module is made into a compact, and since manufacture is easy, saving of an installation tooth space and cheap-ization of a module manufacturing cost can be measured.

CLAIMS

[Claim(s)]
[Claim 1] Are loaded with two or more hollow fibers into housing, and after the membranous

inside has carried out opening, the closure of the both ends of a hollow fiber is carried out into housing, respectively. And it is the hollow fiber mold module which has the end connection which leads to the outside of a hollow fiber. The septum of gas impermeability is formed so that a hollow fiber may be divided in housing at two or more groups. The hollow fiber mold module characterized by being that in which a part thru/or all of a part to which this septum does not have opening in the location from one closure section to at least 50% of the distance between the closure sections, but exceeds it is carrying out opening.

[Claim 2] The hollow fiber mold module according to claim 1 whose septum is what does not have opening in the location from one closure section to at least 80% of the distance between the closure sections, but has opening into the part exceeding it.

[Claim 3] The hollow fiber mold module according to claim 1 which is what does not have a septum in the part which a septum exists in the location from one closure section to at least 80% of the distance between the closure sections, and exceeds it.

[Claim 4] The hollow fiber mold module of any one publication of claim 1-3 prepared in the location with the end connection near the location as for which the diaphragm is carrying out opening which leads to the outside of a hollow fiber.

[Claim 5] It is the hollow fiber mold module by which it was loaded with two or more hollow fibers into housing, and the closure was carried out into housing, respectively after the membranous inside had carried out opening of the both ends of a hollow fiber. In housing, the septum of gas impermeability is formed over between [whole] both closure sections so that a hollow fiber may be divided into two or more groups. And any group of a hollow fiber is surrounded with a septum and housing. The hollow fiber mold module characterized by preparing the channel which connects the end connection which leads to each space separated from one closure section of the inside of housing by the septum within the limits of 70 - 100% of the distance between the closure sections, and the outside of a hollow fiber.

[Claim 6] The hollow fiber mold module of any one publication of claim 1-5 whose values which **(ed) the diameter of circle equal to the cross sectional area of the space surrounded with the space or the septum surrounded by the septum, and housing in the distance between the closure sections are 0.01-0.1.

[Claim 7] The hollow fiber mold module of any one publication of claim 1-6 whose group of a hollow fiber is the bundle of an parallel hollow fiber.

[Claim 8] Each space or the septum surrounded by the septum, and the hollow fiber mold module of any one publication of claim 1-7 whose filling factor of the hollow fiber in each space surrounded with housing is 45 - 80%.

[Claim 9] The hollow fiber mold module of any one publication of claim 1-8 with which the group of the hollow fiber divided by the septum consists of 100-10000 hollow fibers, respectively.

[Claim 10] The hollow fiber mold module according to claim 1 or 5 whose module is an object for gas separation.

11　　12

【図面の簡単な説明】

【図1】従来のモジュールの部分縦断面正面図である。

【図2】本発明の実施例で使用するモジュールの縦断面正面図である。

【図3】本発明の実施例で使用するモジュールの縦断面正面図である。

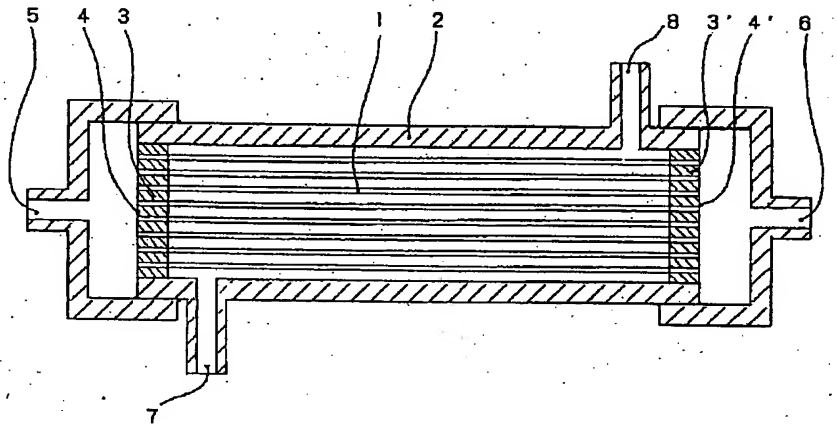
【図4】図2および図3のA部における横断面側面図である。

【図5】本発明の実施例で使用するモジュールの縦断面正面図である。

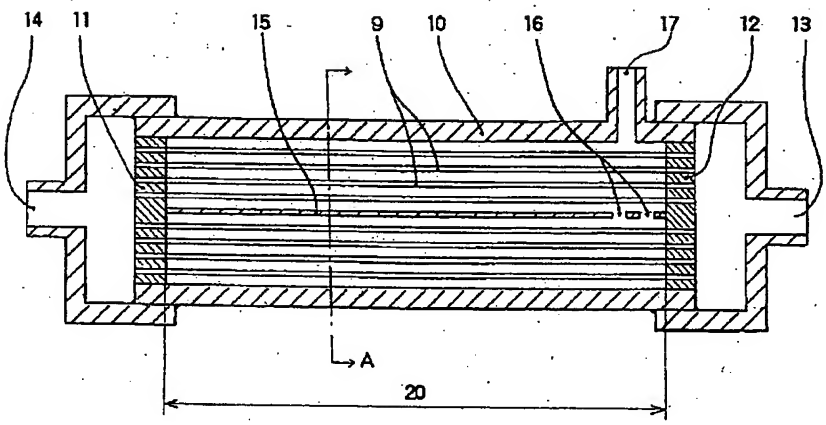
【符号の説明】

1　中空糸膜
2　ハウジング
3、3'　封止部
4、4'　封止部端面
5、6、7、8　接続口
9　中空糸膜
10　ハウジング
11、12　封止部
13、14　接続口
15　隔壁
16　隔壁の開口部
17　接続口
18　隔壁の欠損部
19　チャンネル
20　封止部間距離

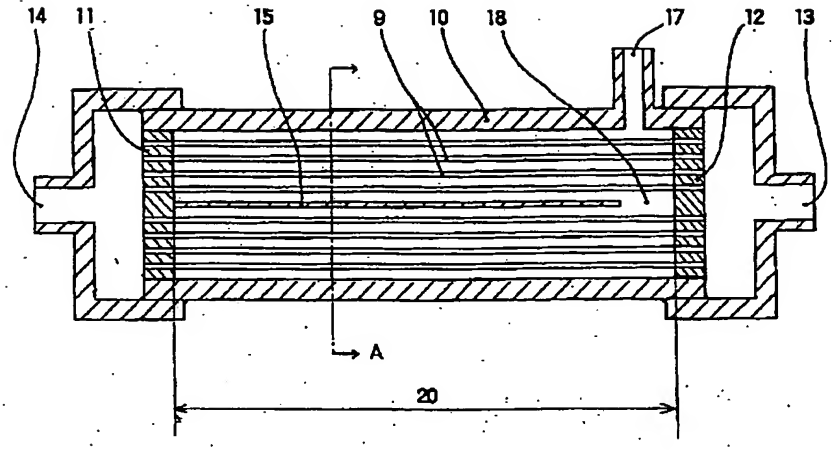
【図1】



【図2】



【図3】


14
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9
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17
12
13
A
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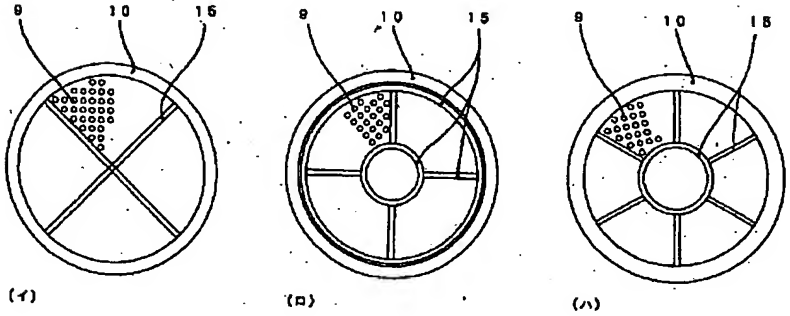
【図4】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9
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9
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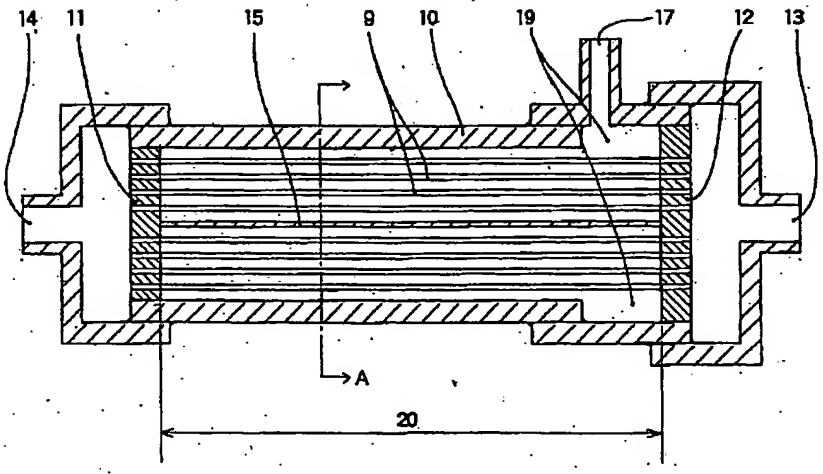
15
(ハ)

【図5】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PN - JP8108049 A 19960430
TI - HOLLOW FIBER MEMBRANE TYPE MODULE
IC - B01D63/02
FT - 4D006/GA25 ; 4D006/GA41 ; 4D006/HA02 ; 4D006/HA15 ; 4D006/HA19 ; 4D006/JA25A; 4D006/JA25C; 4D006/JA29A; 4D006/JA29C; 4D006/MC62 ; 4D006/PB14 ; 4D006/PB62 ; 4D006/PB63 ; 4D006/PB64 ; 4D006/PB66 ; 4D006/PB68 ; 4D006/PB70
FI - B01D63/02
PA - DAINIPPON INK & CHEMICALS
IN - ANAZAWA TAKANORI
PD - 1996-04-30
AP - JP19940249281 19941014
PR - JP19940249281 19941014
DT - I

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AN - 1996-262831 [27]
TI - Gas sepn. module with increased yield of gas sepn. - has hollow fibre membranes housed in barrel and partitioned into gps. by barrier wall through which holes are formed
AB - J08108049 Hollow fibre membranes are housed in a barrel and partitioned into gps. by a barrier wall through which holes are formed.
- ADVANTAGE - The yield of gas sepn. can be increased.
- (Dwg.0/5)
IW - GAS SEPARATE MODULE INCREASE YIELD GAS SEPARATE HOLLOW FIBRE MEMBRANE HOUSE BARREL PARTITION GROUP BARRIER WALL THROUGH HOLE FORMING
PN - JP8108049 A 19960430 DW199627 B01D63/02 008pp
IC - B01D63/02
MC - J01-C03
DC - J01
PA - (DNIN) DAINIPPON INK & CHEM INC
AP - JP19940249281 19941014
PR - JP19940249281 19941014

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PN - JP8108049 A 19960430
TI - HOLLOW FIBER MEMBRANE TYPE MODULE
AB - PURPOSE: To prevent the packed quantity of hollow fiber membranes from being reduced while making the flow of a gas flow outside the hollow fiber membranes approach a contercurrent model by forming no opening within a specified distance from one sealing part to a partition installed in the hollow fiber membrane and making a part exceeding it have an opening.
- CONSTITUTION: Plural hollow fiber membranes 9 are fitted in a housing 10, and both the ends of the hollow fiber membranes 9 are sealed in a housing 10 with the inside of the membranes 9 being opened, and the housing is provided with connecting ports 13, 14 communicating with the outside of the hollow fiber membranes 9. And in the housing 10, a partition 15 of gas impermeable partition 15 is installed so that the hollow fiber membranes 9 may be divided into plural sets. The partition 15 has no opening at a position within a distance, at least 50% of the distance between one sealing part 11 (12), from the sealing part, and a part or the whole of a portion exceeding it is opened. In this way, performance approaching a countercurrent is realized, and the quantity of the hollow fiber membranes packed into the module is not reduced.
I - B01D63/02
PA - DAINIPPON INK & CHEM INC
IN - ANAZAWA TAKANORI
ABD - 19960830